Is Attainment of Greater Height and Body Size Really Desirable?

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Physicians and pediatricians in the United States are often urged by parents to use recombinant growth hormone (rGH) to increase the height of their children or to ensure that their children will achieve their genetically determined height. Decisions to recommend rGH for a non-GH deficient child depend on medical and psychosocial factors. Accordingly, future rGH use will depend on the results of controlled trials, family preferences, cost, and physician perceptions of the value of GH therapy and greater height.

Except for children who are short due to hormonal deficiency, pressure to treat normal short children stems from psychosocial conditioning that "taller is better." Yet, evaluation of human height and its benefits and disadvantages reveals that shorter height and associated lower body weight have many advantages for the individual and society. Thus, a more positive attitude toward shorter stature is warranted. It is hoped that the following information will be useful to physicians in helping parents and children accept shorter stature with a positive attitude.

Anthropologists Montagu and Stini,[1] chemist Alexander,[2] and Nobel laureate in physics Townes have recognized the benefits of a world population of shorter, smaller people. Walker et al[3] also have challenged the value of reaching our maximum genetic potential in height.[3] In fact, recent research indicates that a shorter, lighter human configuration offers many benefits to the individual and the planet.[4]

The belief in the superiority of taller stature stems from primitive times when greater size and strength were useful in intimidating or fighting enemies or hostile animals. In the modern world, children grow up in a world of "giants" who control most aspects of their lives, and they associate larger size with authority, knowledge, pleasure, punishment, and power. As adults, childhood experience is translated into greater respect for taller people, who often receive higher pay and hold leadership positions.

While most people believe increasing stature over the past 150 years is a natural product of evolution, recent anthropologic findings indicate that we have been declining in height and weight for the past 30,000 to 50,000 years.[5]

Based on increasing life expectancy, improved standards of living, medical advances, and abundant food, we have assumed that taller stature is a positive aspect of modern civilization. An in-depth study evaluating Western nutrition by the World Health Organization (WHO) challenged many Western beliefs.[6] While applauding the widespread elimination of malnutrition and infectious diseases, it laid much of the epidemic of heart disease, cancer, diabetes, and other chronic diseases at the doorstep of modern dietary practices. Yet, our contemporary diet and associated greater stature are still viewed in a positive light by the public and many medical practitioners.

The belief that taller stature has a positive health value has been supported by several major studies showing a correlation between short stature and high-

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er death rates and coronary heart disease. However, these studies have not explained a number of contradictory findings. For example, shorter, smaller people of Japan and Hong Kong live longer than Northern Europeans; shorter and lighter Okinawans live longer than taller mainland Japanese[7]; and women throughout the world are shorter and smaller than men and also live longer.

Other studies have found shorter people have fewer deaths from coronary heart disease and other causes. A study by the Karolinska Institute in Sweden tracked 50,000 men for 18 years and found that taller men have higher mortality from coronary heart disease and respiratory problems. The rural Chinese have roughly one-tenth the death rate from heart disease in the West, and men in Shanghai had a greater life expectancy than that of US men in 1989.

The reasons for conflicting findings are probably due to the limitations of epidemiologic studies; many variables exist in human studies such as socioeconomic, body type, lifestyle, diet, exercise, smoking, alcohol, drugs, environment, medical care, and cultural differences. Genetics play a role, but numerous studies have shown that migrating people quickly acquire many of the chronic diseases of their new countries. To provide a more balanced picture of how height and nutrition relate to health and longevity, some lesser known findings are presented next.

Through 20 years of Third World research, investigators have found that traditional rural diets are much healthier than Western diets. After reviewing reports from approximately 1000 Third World hospitals, Temple and Burkin[8] found that rural people following traditional diets suffered almost no heart disease, diabetes, or other chronic diseases common to Westerners. They reported that high blood pressure, coronary heart disease, and colon cancer are rare or absent in rural black communities with diets low in calories, total protein, and fat (especially animal fat) but high in fiber. They also found that Western populations had a much lower incidence of Western diseases when shortages of energy-rich foods occurred during World War II. Researchers also have shown that Africans who eat less and do not attain their maximum genetic potential for height have fewer chronic diseases[3] and that Masai on a sparse diet were found to be healthier than Masai who were fed more.[9]

During the biosphere experiment, Walford et al[10] monitored the health of the eight inhabitants of the essentially self-sustaining mini-world. The biosphere inhabitants lived on a restricted food intake averaging 2000 kcal over a two-year period. The diet was mostly vegetarian except for small amounts of meat and goat milk. A significant drop in body weight and blood pressure occurred, and substantial drops in blood cholesterol, fasting blood sugar, and white blood cell counts were noted.

Elrick et al[11] studied healthy long-living people in eight different countries and found that these individuals ate sparsely and were generally slender and short with BMIs ≤ 20. They also found that short people were often especially rugged, such as the Tarahumara Indians in Mexico, who could run up to 200 miles, stopping only to drink water or deal with bodily functions. With a caloric intake of 1500 kcal/day, they were free of diabetes, hypertension, and coronary heart disease.

American, English, and Chinese researchers in an on-going study in China found that taller, heavier Chinese had a significantly higher incidence of myocardial infarction, coronary heart disease, and cancer.[12] The average man was 5′4.5″ tall and weighed 121 lb, with a BMI of 20.5.

The healthiest and longest living people in the world appear to be Okinawans. Children in Okinawa consume almost 40% fewer calories than those in mainland Japan and are shorter and lighter than their counterparts on the mainland. Okinawa has 15 centenarians per 100,000 population, which is considerably more than the 1 to 9 centenarians in other parts of Japan.[7] Okinawans have a lower incidence of coronary heart disease, stroke, and cancer compared with mainland Japanese. The average heights of Okinawan men and women aged 87-104 years were approximately 4′9″ and 4′7″, respectively.

In 1961, Greeks aged 45 years had the longest life expectancy of the nations tracked by WHO. The Greeks were notable for low heart disease, colon cancer, and breast cancer rates. Yet, the average height of men was $<5'6''$. With the adoption of a more affluent diet of red meat, dairy products, and processed foods, a dramatic rise has occurred in these diseases, although the Greeks, as well as most southern Europeans, still have good longevity and suffer less heart disease and cancer than taller northern Europeans and North Americans.[13]

Baron, of the National Institute of Occupational Safety and Health, studied almost 7000 professional football players and found that the largest players had a six times higher death rate from heart disease compared with the smallest players.[14] Polednak[15]

also reported that shorter athletes (averaging about 19 shorter) had a longer life span (one to three years) than taller athletes.

A study of more than 1700 deceased people in Ohio revealed that shorter men and women lived longer than taller ones.[16] Life span was reduced by 1.2 year/inch. A study of more than 4000 deceased males found that shorter or lighter men lived longer than taller bigger ones (Figure 1) and found the loss of longevity with height to range from .9-1.6 year/inch.[17,18]

A longevity study published in 1996 found that taller people had shorter life spans and suffered more deaths from degenerative diseases.[19] Note that in evaluating the longevity of individuals, height is roughly 10% of the total picture–lifestyle, heredity, medical care, weight for height, and environment have a much greater impact on longevity; thus, a tall, mostly vegetarian individual who is physically fit will certainly live longer than a short, overweight, inactive person.[4,17] Many tall or large people have excellent life expectancies, including athletes and corporate executives.

A comprehensive study of long-lived people in the world concluded that the major characteristic of the diet of long-lived people is low food intake.[20] Most long-lived people had a caloric intake of only 1500-2000 kcal despite being very active. It also was reported that greater body weight over a lifetime is a primary risk factor of premature death, and long-living individuals had body weights below what is considered a healthy weight in the Western world.

A study of approximately 9000 Seventh Day Adventists found that men with BMIs ≤22.3 had the greatest average life span and that life span decreased linearly with increasing values.[21] A recent British study found the ideal BMI to be 19-22.[22] The Framingham Off-Spring study also found that the lowest coronary heart disease occurred in men and women with a BMI of <21.[23] The US Nurses' study also found the lowest mortality risk among females to be <19.[24] These studies don't tell us much about the benefits of shorter stature, but they do indicate that a small body size is consistent with low death rates. For example, a 5′10″ tall man with a BMI of 20 would weigh slightly less than 140 lb. This man is small by today's standards since middle-aged US men average about 184 lb.

Many cancer studies have found a positive correlation between body size and height and increased mortality from breast, endometrial, lung, colon, and other cancers. A Norwegian study of 570,000 women found taller women had a higher incidence of breast cancer.[25] Also, a 1996 study by the National Cancer Institute found a strong correlation between breast cancer and height, with the tallest women having twice the breast cancer of the shortest women.[26] The US Physicians Study recently found that height correlated positively with prostate and all types of cancers.[27]

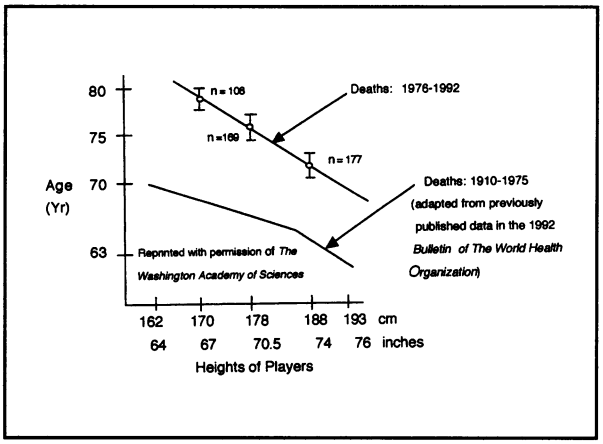

Figure 1.
Longevity of baseball players versus height. (Error bars=$x \pm s_{\bar{x}}$, where $\bar{x}$=mean, $s_{\bar{x}}=s/n^{1/2}$, sx=standard error of the mean, s=standard deviation, and n=sample size. For players who died from 1976-1992, longevity for 67″ players is the average longevity for players 5′5″-5′9″; longevity for 70.5″ player is average longevity for players 5′10″-5′11″; and longevity for 74″ players is the average longevity for players 6′-6′4″. The sharp drop for deaths between 1910 and 1975 appears to be an anomaly based on the death pattern for players who died after 1975.)

In California, the shorter and lighter Asian and Hispanic populations have a life expectancy about 4 years longer than whites.[28] On a nationwide basis, government statistics indicate that Asians, Hispanics, and American Indians have considerably lower mortality from coronary heart disease and cancer. Compared with whites, Asians have a lower death rate for all age groups and Hispanics have a substantially lower death rate for age groups >45 years. Native American men also have lower death rates for age groups >55 years.[29]

Strong support for the health advantages of restricted caloric intake and smaller body size stems from 60 years of animal research, which has found reduced disease and longer life among animals on 30%-50% calorie restricted diets.[30] Almost 100% success has been achieved in extending the maximum

life span of various animals. This caloric reduction results in smaller animals that live up to two times longer than animals that eat all they want. Although there is a trend for longer life based on increasing size for different species, smaller mammals within a species generally live longer than bigger ones.[31] Various researchers have found that within a species, smaller animals live longer.[32]

Besides the health benefits of a restricted diet and associated reduced body size, there are physical advantages to smaller human size. While taller people have greater absolute strength and reach, the laws of geometric scaling indicate that smaller bodies of the same configuration as taller ones have the following advantages[4]:

- greater strength on a pound-for-pound basis,
- greater endurance,
- greater ability to accelerate or react quickly,
- greater agility due to lower rotational inertia and quicker acceleration,
- greater capability to get rid of body heat during vigorous physical activities,
- greater energy output per unit time on a pound-for-pound basis,
- less stress on joints, tendons, bones, and ligaments,
- lower food and water needs, and
- more athletic and less prone to injury.

Increasing height and nutrition can be correlated with greater productivity of the developed world because the most highly developed countries are generally the tallest (eg, Holland, Sweden, Norway, Germany, and the United States). However, the Japanese industrial and economic achievements following World War II were implemented by small people, with the average height of Japanese men being 5′3″.

Modern Asians also show great economic and production capabilities, such as in China, Hong Kong, Taiwan, South Korea, and Vietnam. Other high achievers include the Ancient Greeks and Romans who ranged in height from 5′4″ to 5′6″, and the Mayans, Incas, and Aztecs were short people as were the Egyptians and East Indians.

Despite our focus on large and tall athletes, small people can make great athletes and soldiers also as evidenced by the ancient Greeks and Romans. The Atlanta Olympic games demonstrated that short people make outstanding gymnasts, weightlifters, divers, wrestlers, boxers, and marathon runners. The average height of the seven American Gold medal women gymnasts was <5′. Josia Thugwane, 5′2″, was the first black South African to win an Olympic gold medal in the 1996 Atlanta Olympics. Other studies have shown champion distance runners tend to be short and lean, eg, the 1995 NY Marathon was won 2 years in a row by German Silva, 5′3″ and 110 lb, and Tegla Loroupe, about 5′1″ and 80 lb. There also have been exceptional short sprinters and hurdlers, such as Olympian Gail Devers, 5′3″ and 115 lb. In the 1998 winter Olympics, 5′4″ Hiroyasu Shimizu won the 500-m speed skating event.

Smaller people also require less food and water in a world that may have 12 billion people by the year 2050. For a world using machines to do much of our work, a smaller body is more efficient because it requires less input for the same output. A population of 20% taller Americans would require an additional 180 million acres of farmland to supply their greater food needs.[4]

Populations of larger people also produce more pollution and use more resources. For example, a 20% taller and 73% heavier US population would require at least 600 million tons of additional natural resources on an annual basis.[4] This population also would produce an additional 80 million tons of garbage annually.

In view of the many advantages to smaller human size, the scientific community needs to reevaluate the desirability of promoting taller stature before it impacts our ability to conserve the earth and to survive as a species. The Japanese have grown about 4″ following World War II when they began eating a more Western style diet with a dramatic increase in chronic diseases. The Chinese also are increasing in height and coronary heart disease. Other Asian, African, and South American peoples will grow taller as their countries become more developed. The resource, water, and food needs of 3.1 billion larger Asians will compound the world's problems in providing everyone with clean water, food, good health, and a decent standard of living.

We need to understand the harmful forces at work when a population of people is larger across the board. Growth experts Eveleth and Tanner have observed that researchers are questioning nutritional practices promoting maximum human growth because smaller and not larger body size may lead to better health and longevity.[33] Many years ago, Stini observed that maximizing growth was not the

same as optimizing it. He correctly observed that many problems were associated with increasing body size including increased degenerative diseases such as cancer.[1] A new study on height and health supports his early findings.[34] We also have to realize that with genetic engineering, the adulation of tall stature can result in a population that is well in excess of our current experience.

Contrary to popular beliefs, researchers have found that the psychosocial functioning of short children appears to be quite normal.[35] If short children are not having problems with their heights, it may not be as difficult as we think to change people's views about the advantages of shorter height and lower body weight. We believe that the first step in eliminating height bias in the world must begin with the scientific community, and we urge scientists and medical professionals to educate their patients, students, and the public about the advantages of smaller human size.

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